CLAIMS

What is claimed is:

1. A method of seismic data processing to correct for variable water velocities, the method comprising:
   (a) determining an observed velocity;
   (b) determining a vertical time correction using said observed velocity; and
   (c) applying said vertical time correction to seismic data before normal moveout.

2. The method of claim 1 wherein determining an observed velocity further comprises determining V_{obs} from $V_{obs} = V_w\left(\Delta t / T_{obs} + 1\right)$

3. The method of claim 1 wherein determining an observed velocity further comprises determining V_{obs} from velocity analysis of a seismic gather.

4. The method of claim 1 wherein determining said vertical time correction further comprises determining a time-dependent and offset-dependent correction for at least one sample of the seismic data.

5. The method of claim 1 wherein said vertical time correction is of the form $\Delta t(\theta) = T_{obs}\left(V_{obs}/V_w - 1\right)\Big/\left\{1 - \left[HV_{obs}/\left(T_{refl}(H)V_{rms}^2\right)\right]^2\right\}^{1/2}$ where V_w is a selected ideal velocity.

6. A method for determining a water velocity correction for seismic data, the method comprising:

(a) determining a zero-offset static correction, Δt, for the seismic data that is the difference between an observed time to a water bottom and an ideal time to a water bottom determined using a selected ideal velocity;

(b) selecting an ideal water velocity, V_w, for the seismic data;

(c) determining a zero-offset water bottom time for the seismic data;

(d) determining an observed velocity, V_{obs}, for the seismic data; and

(e) determining a water velocity dynamic correction.

7. The method of claim 6 wherein determining said water velocity time correction further comprises determining a time-dependent and offset-dependent correction for at least one sample of the seismic data.

8. The method of claim 6 wherein said water velocity dynamic correction is of the form $\Delta t(\theta) = T_{obs}\left(V_{obs}/V_w - 1\right)\Big/\left\{1 - \left[HV_{obs}/\left(T_{refl}(H)V_{rms}^2\right)\right]^2\right\}^{1/2}$.

9. The method of claim 6 wherein said water velocity dynamic correction is determined for at least one source-receiver offset.

10. The method of claim 6 wherein deriving said water velocity dynamic correction further comprises determining at least one angle of seismic data raypaths for at least one source-receiver offset.

11. The method of claim 6 wherein determining an angle of seismic raypaths through the water uses velocities from at least one of the list consisting of: i) normal moveout velocities V_{rms}, ii) observed velocities V_{obs}, and iii) ideal velocities V_w.

12. The method of claim 6 wherein determining said water velocity dynamic correction further comprises determining at least one seismic raypath through the water using velocities from at least one of the list consisting of: i) normal moveout velocities V_{rms}, ii) observed velocities V_{obs}, and iii) ideal velocities V_w.

13. The method of claim 12 wherein deriving said seismic raypaths further comprises determining raypaths between a water surface and a water bottom, said water bottom defined by using at least one of the group consisting of i) T_w, ii) T_{obs} and iii) an arbitrary water bottom model.

14. The method of claim 6 wherein deriving said water velocity dynamic correction further comprises determining V_{obs} from $V_{obs} = V_w\left(\Delta t / T_{obs} + 1\right)$

15. The method of claim 6 wherein deriving said water velocity dynamic correction further comprises determining V_{obs} from velocity analysis of a seismic gather.

16. A method of seismic data processing, the method comprising:

(a) determining a zero-offset static correction, Δt, for the seismic data that is the difference between an observed time to a water bottom and an ideal time to a water bottom determined using a selected ideal velocity;

(b) selecting an ideal water velocity, V_w, for the seismic data;

(c) determining a zero-offset water bottom time for the seismic data;

(d) determining an observed velocity, V_{obs}, for the seismic data;

(e) determining a water velocity dynamic correction; and

(f) applying said water velocity dynamic correction to seismic data.

17. The method of claim 16 wherein said water velocity dynamic correction is substantially of the form $\Delta t(\theta) = T_{obs}\left(V_{obs}/V_w - 1\right)\Big/\left\{1 - \left[HV_{obs}/\left(T_{refl}(H)V_{rms}^2\right)\right]^2\right\}^{1/2}$.

18. The method of claim 16 wherein determining an observed velocity, V_{obs}, is of the form $V_{obs} = V_w\left(\Delta t/T_{obs} + 1\right)$

19. The method of claim 16 wherein said water velocity dynamic correction is determined for at least one source-receiver offset.

20. The method of claim 16 wherein determining said water velocity dynamic correction further comprises determining at least one seismic raypath through the water using velocities from at least one of the list consisting of: i) normal moveout velocities V_{rms}, ii) observed velocities V_{obs}, and iii) ideal velocities V_w.

21. The method of claim 20 wherein deriving said seismic raypaths further comprises determining raypaths between seismic receivers and a water bottom defined by at least one of the group consisting of i) T_w, ii) T_{obs} and iii) an arbitrary water bottom model.

22. The method of claim 16 wherein deriving said water velocity dynamic correction further comprises determining V_{obs} from $V_{obs} = V_w\left(\Delta t/T_{obs} + 1\right)$

23. The method of claim 16 wherein deriving said water velocity dynamic correction further comprises determining V_{obs} from velocity analysis of a seismic gather.

24. A method of seismic data processing to correct for variable water velocities, the method comprising:

(a) determining an observed velocity;

(b) determining an angle dependent time correction using said observed velocity; and

(c) applying said angle dependent time correction to seismic data before normal moveout.

25. The method of claim 24 wherein determining said observed velocity further comprises determining V_{obs} from $V_{obs} = V_w\left(\Delta t / T_{obs} + 1\right)$

26. The method of claim 24 wherein determining said observed velocity further comprises determining V_{obs} from velocity analysis of a seismic gather.

27. The method of claim 24 wherein determining said angle dependent time correction further comprises determining a time-dependent and offset-dependent correction for at least one sample of the seismic data.

28. The method of claim 24 wherein said vertical time correction Δt, is of the form $\Delta t(\theta) = T_{obs}\left(V_{obs}/V_w - 1\right)\Big/\left\{1 - \left[HV_{obs}/\left(T_{refl}(H)V_{rms}^2\right)\right]^2\right\}^{1/2}$ where V_w is a selected ideal velocity.